

LANDING SITE TARGETING AND CONSTRAINTS FOR EXOMARS 2016 MISSION

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ABSTRACT

The EXOMARS program, led by the European Space Agency and with Thales Alenia Space Italia as prime contractor, foresees two missions: the first, led by ESA, to be launched in 2016, consisting of an Orbiter plus an Entry, Descent and Landing Demonstrator and the second, led by NASA, with a launch date of 2018.

For the 2016 mission scenario, EDL of a 2.4 m 600 kg class Experimental Descent Module will be under TAS-I responsibility, while for the 2018 mission scenario a European Rover Module will be hosted on a landing platform with the American rover, with EDL responsibility held by Jet Propulsion Laboratory (JPL).

Selection of the landing sites will therefore undergo two separate and distinct processes. This paper presents the approach followed by TAS-I for the identification of the targeting and risk assessment of the EDM-2016 Exomars Mission.

EDM-2016 will be on board of an Orbiter Module that will act as Data Relay for EDM EDL and surface science phase limited to 8 sol. The Orbiter Module will then acquire a Science Orbit of inclination 73.6° with a 6 to 9 months aerobraking phase, perform one year scientific mission and act as Data Relay orbiter for the 2018 mission. Launch of the EDM-OM composite will occur from Johnson Space Center on an Atlas V 421 launcher, with a 21 days window starting on January 6, 2016. Arrival will occur on a fixed date, October 16, 2016, with hyperbolic excess velocities in the range 3.25 to 3.46 km/s. EDM will then be released from OM 3 days before Entry Interface Point, conventionally fixed at 3517.5 km radial distance. EDM will perform the entry, descent under supersonic Disk Gap Band parachute and terminal braking of a Surface Platform hosting a propulsion module with 3 clusters of engines operated in Pulse Width Modulation and implementing a semi-soft landing system to attenuate the impact loads at touchdown.

The specific need to harmonize the final science orbit as well as the execution of a safe EDL demonstration poses several limits on the flexibility of the mission, owing to launchability constraint (mass).

The process for identifying a suitable landing site has therefore undergone some shortcuts, based on the analyses run in Phase B1 of the project and on the knowledge acquired during these past years of Mars observation. The Meridiani region has been selected as a reference landing site mainly for being well known and widely covered by several observations from past orbiters (MGS, Odyssey, Mars Express, MRO) as well as by the in-situ observations of the MER-B (Opportunity) rover.

The analysis of the requirements for EDM, as well as the identification of specific design constraints, is being considered in parallel to the process of analyzing, characterizing and certifying the landing ellipse hazards through a detailed process of engineering analysis of the target site in terms of slopes, craters, rock abundance, thermal properties as well as atmospheric characteristics affecting the whole EDL phase.

In this paper, the methodology for hazard identification and EDL mission success analysis are presented.